
Chapter 1 — ISDN and DTI Interfaces

Overview

Integrated Services Digital Network (ISDN) is a global networking strategy that provides a single, intelligent, universal network for voice and data communications. ISDN is a set of international standards that define the next generation of digital networking services.

Some of the benefits of ISDN are as follows:

- faster, more accurate, noise-free transmission, as well as greater security and reliability
- ability to carry multiple information types, including speech, data, image, and video
- standard interfaces to allow multi-vendor compatibility
- configuration flexibility when combining public and private networking facilities.

ISDN differs from traditional communication in that it uses “out-of-band” signaling. Signals are sent and received on a dedicated D-channel, leaving the remaining channels, called B-channels, free for voice and data.

Signaling and trunks

The terms *signaling* and *trunks* are used throughout this document. The following paragraphs briefly explain what they mean.

Trunks

Trunks are transmission channels that carry voice, data and signaling information between switching systems in the network. They can be classified based on two parameters:

- 1 the type of service supported on the trunk, for example Wide Area Telephone Service (WATS), Direct Inward Dial (DID), Foreign Exchange (FX) or tie trunks.
- 2 the nature of the signal that is transmitted, either analogue or digital.

Analogue trunks are provided on voice-frequency (VF) facilities that are operated in either 2-wire or 4-wire mode. They support speech or voice-grade data, both of which require a bandwidth of about 3.1 kilohertz (kHz).

Digital trunks are 64 kbps data channels that carry voice, data, or signaling information.

Signaling

Signaling is the process of transferring information between two parts of a network in order to control call connections and related operations. Some examples of signaling information are call set-up messages, call take-down messages, calling-line identification, and feature-activation information.

Prior to ISDN and common channel signaling, each trunk carried its own signaling together with the voice or data portion of the call. This scheme is referred to as per-trunk, or inband signaling.

With ISDN and out-of-band signaling, signaling is performed on a single D-channel. This leaves the other channels, called B-channels, clear for voice and data transport, and maximizes the efficiency of the carrier.

Network interfaces

A network interface is physically composed of a collection of trunks, each of which carries signaling and/or user information.

In a Meridian Network, four basic elements must be in place and functioning in order to support the networking services desired. These are:

- network interfaces
- network numbering plan
- network route selection
- network control

Network interfaces physically and logically connect the switches in a network. One of the initial steps in building a network, therefore, is to define and implement the types of interfaces that are required.

The prime focus of this document is the implementation, on an Option 11 system, of six types of network interfaces:

- 2 Mb Digital Trunk Interface (2 Mb DTI) that supports the E-1 carrier
- 2 Mb Primary Rate Interface (2 Mb PRI), a CCITT-specified interface that supports E-1 carrier
- ISDN Signaling Link (ISL), a Northern Telecom proprietary interface that supports analogue and/or digital trunks
- ISDN Signaling Link (ISL) to Analogue Private Network Signaling Scheme (APNSS)
- Digital Private Network Signaling System (DPNSS1)
- Digital Access Signaling Scheme (DASS2) to Q.931

The implementation of each of the above-named interfaces is described in this document.

Digital Trunk Interface (DTI)

Digital Trunk Interface (DTI) pre-dates ISDN and Primary Interface (PRI). DTI is a networking scheme that connects an Option 11 to another Private Branch Exchanges (PBXs) or central office (CO). Digital carriers (E-1s) are used to carry voice and data information instead of using dedicated trunks.

Thirty B-channels are available on the 2 Mb DTI for voice and data transmission. Each B-channel is assigned a 2 Kbps signaling channel within the CEPT multiframe, which consists of 16 frames. This networking arrangement, like PRI, makes use of a digital carrier instead of using dedicated trunks. In DTI, “A” and “B” bits are used to imitate traditional trunk signaling (ground start, loop start, and so on).

Table 1 shows the impact that out-of-band (PRI) signaling versus in-band (DTI) signaling has on data transmission.

Table 1
DTI and PRI data transmission

Data Transmission Types	DTI	PRI
Asynchronous	up to 19.2 kbps	up to 19.2 kbps
Synchronous	up to 64 kbps	up to 64 kbps

ISDN interfaces

Meridian 1 Networking supports three ISDN interfaces:

- Primary Rate Interface (PRI): 30B+D
- Primary Rate Interface (PRI): nB+D
- ISDN Signaling Link (ISL): nB+D
- 2B+D Basic Rate Interface (2B+D BRI)

Note: As noted earlier, this document does not contain information on ISDN BRI - this information is contained in the *ISDN BRI Administration and Maintenance* 553-3011-311.

Primary Rate Interface (PRI)

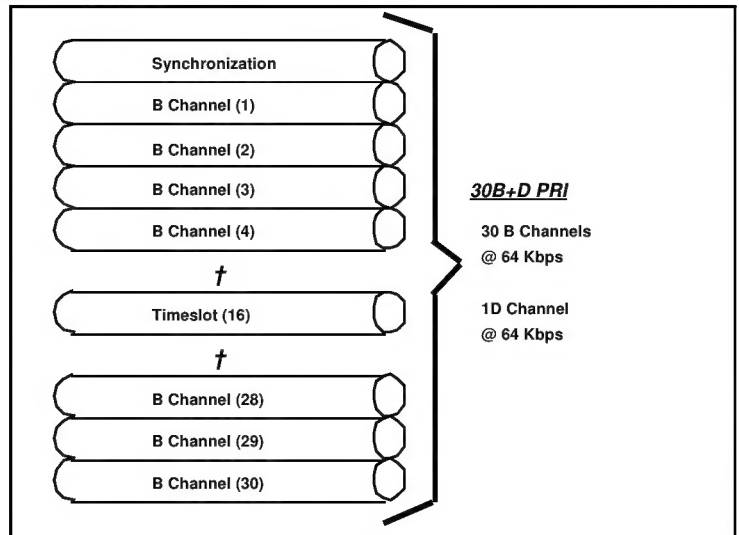
Primary Rate Interface is characterized by digital carriers and out-of-band signaling. All signaling is done over a D-channel, leaving the remaining B-channels free for voice and data transmission. The D-channel carries all the call set-up, call tear-down, calling line identification, and feature activation information.

PRI is referred to as either “30B+D” or “nB+D”. This distinction is based on the fact that one D-channel can support multiple digital carriers. In other words, the choice exists to have one D-channel per digital carrier, or to have one D-channel support a number of carriers.

30B+D Primary Rate Interface

In the 30B+D PRI arrangement, each digital carrier (E-1) has its own D-channel. There are 32 timeslots per E-1 carrier: timeslot zero is reserved for framing information, timeslot 16 is used as the D-channel, leaving 30 channels for voice and data. The B-channels are “clear” channels, meaning all 64 K are used for voice and data. The 30 B channels plus one D-channel structure conforms to the CCITT specification (I.431) for PRI layer 1 protocol.

Figure 1
30B+D Primary Rate Interface Structure



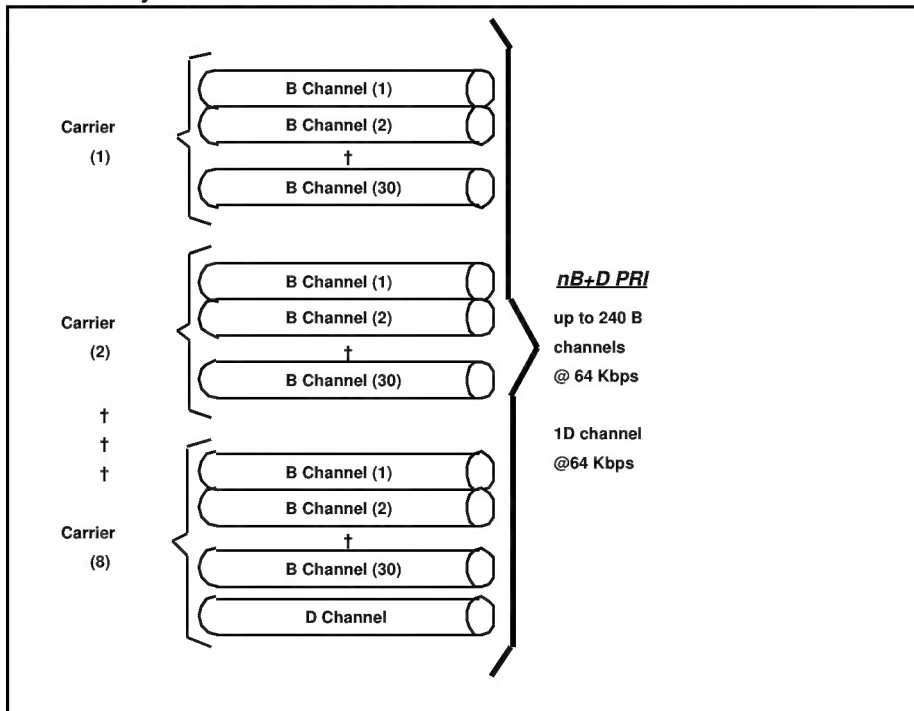
nB+D Primary Rate Interface

In an nB+D PRI arrangement, one D-channel supports multiple digital carriers. A back-up D-channel is usually recommended when one D-channel is supporting a large number of channels.

CCITT currently specifies the PRI layer 1 protocol as a 30 + B structure. Layer 3 (Q.931), however, supports a larger PRI made up of multiple digital carrier facilities.

On the Option 11 system, a maximum of eight NTAK79 or NTBK50 2 Mb PRI cards can be installed in the main cabinet. The maximum number of B-channels is 240 (8 X 30).

Figure 2
The nB+D Primary Rate Interface Structure



Option 11 PRI configurations

Option 11 2 Mb PRI is supported in the following system configurations:

- Meridian 1 Option 11 to Meridian 1/SL-1
- Meridian 1 Option 11 to Meridian 1 SL-100
- Meridian 1 Option 11 to DMS-100
- Meridian 1 Option 11 to DMS-250
- Meridian 1 Option 11 to EuroISDN
- Meridian 1 Option 11 to AT&T ESS#4
- Meridian 1 Option 11 to AT&T ESS#5
- Meridian 1 Option 11 to Australian AXE-10
- Meridian 1 Option 11 to QSIG Basic Call
- Meridian 1 Option 11 to Swedish AXE-10
- Meridian 1 Option 11 to Swissnet
- Meridian 1 Option 11 to New Zealand NEAX-61
- Meridian 1 Option 11 to Norwegian SYS-12
- Meridian 1 Option 11 to Numeris France
- Meridian 1 Option 11 to Japan D70
- Meridian 1 Option 11 to 1 TR 6
- Meridian 1 Option 11 to Asia-Pacific, consisting of:
 - Australia
 - Hong Kong
 - New Zealand
 - Singapore

Option 11 to Meridian 1/SL-1—features and functions

The following is a list of the features and functions supported on 2 Mb PRI between Meridian 1 or SL-1 systems:

- Basic Call Service
- 64K Clear Data Transmission
- Calling Line Identification (CLID)
- Calling Line Identification (CLID) in Call Detail Recording (CDR)
- Electronic Switched Network (ESN) Interworking
- ISDN Signaling Link (ISL)
- Backup D-channel
- 30B+D (Non-associated D-channel)
- Network Call Redirection
- Network Call Party Name Display (NCPND)
- Network Message Services (NMS)
- Network Ring Again (NRAG)

Option 11 to AXE-10 or SYS-12 CO—features and functions

The following is a list of the features and functions supported on 2 Mb PRI AXE-10 or SYS-12 configurations:

- Basic Call Service
- 64K Clear Data Transmission
- Connected Number Delivery
- Calling Line Identification (CLID)
- Calling Line Identification (CLID) in Call Detail Recording (CDR)
- Central Office Trunk (COT), Direct Inward Dial (DID), Direct Outward Dial (DOD) and Tie call types
- Channel Negotiation
- 30B+D (Non-associated D-channel)

Option 11 to 1 TR 6 D-channel protocol—features and functions

The following is a list of the features and functions supported on 2 Mb PRI 1 TR 6 D-channel protocol configurations:

- Basic Call Service
- 64K Clear Data Transmission
- Connected Number Delivery
- Calling Line Identification (CLID)
- Calling Line Identification (CLID) in Call Detail Recording (CDR)
- Central Office Trunk (COT), Direct Inward Dial (DID), Direct Outward Dial (DOD) and Tie call types
- Channel Negotiation
- 30B+D (Non-associated D-channel)
- Call Charge Indication to Calling Party
- Tandem Call Restrictions

Option 11 to EuroISDN—features and functions

The EuroISDN interface supports the following features and functions:

- Basic call service
- 64 kbps clear channel
- DID, DOD, and COT call types
- Channel negotiation
- Overlap sending and receiving
- Flexible Numbering Plan
- Calling Line Identification Presentation and Restriction
- Connected Line Presentation and Restriction

Option 11 to France Numeris—features and functions

The following is a list of the features and functions supported on ISDN Numeris configurations:

- Basic call service
- Circuit-switched voice and data on the B-channel
- Called/calling party subaddress (network-wide)
- Support for COT, DID, DOD, and TIE trunk types
- Channel negotiation
- 64 kbps clear bearer capability
- Flexible numbering plan
- Total call cost

Option 11 to QSIG Basic Call—features and functions

The QSIG interface supports the following features and functions:

- Call establishment and tear down
- ETSI or ISO version of basic call
- 64 kbps clear
- Overlap sending/receiving
- Channel negotiation
- Calling and Connected Parties Information (CLIP/COLP)
- Calling and Connected Parties Restriction (CLIR/COLR)
- Flexible Numbering Plan
- TIE call types
- nB+D (non-associated D-channel)
- Transit count information transmission when ISDN Call Connection Limitation (ICCL) is present.

Option 11 to New Zealand NEAX-61—features and functions

The following is a list of features and functions supported on Option 11 to New Zealand NEAX-61 configurations:

- Basic call service
- Calling Line Identification (public and private)
- Overlap sending
- COT, DID, DOD, and TIE trunk types
- 64 kbps clear
- Channel negotiation
- nB+D, up to 120 B-channels/four interfaces
- Public Switched Telephone Network (PSTN) three-party conferencing
- Flexible Numbering Plan
- Malicious Call Trace

Option 11 to SwissNet—features and functions

The following basic services are provided for this initial offering of the ISDN PRA Meridian 1 to SwissNet connectivity:

- Basic Call Service;
- Calling Line Identification (CLID) and Calling Line Restriction (CLIR);
- COT, DID, DOD, TIE trunks call types;
- 64 kb/s clear bearer capability;
- Channel Negotiation;
- Advice of Charge at End of Call;
- Overlap Signaling;
- Flexible Numbering Plan.

Option 11 to Japan D70—features and functions

The following basic services are provided for the ISDN INS1500 D70 for Japan connectivity (note that the design is based on the 23 B+D PRI configuration):

- Basic Call Service
- Calling Line Identification (public and private)
- Overlap Sending
- COT, DID, DOD, and TIE trunk call types
- 64 kbps clear bearer capability
- Channel Negotiation
- nB+D, up to 120 B-channels/four interfaces
- Public Switched Telephone Network (PSTN) three-party conferencing
- Flexible Numbering Plan
- Malicious Call Trace

Option 11 to Asia-Pacific —features and functions

This ISDN PRI Meridian 1 to Asia Pacific Connectivity provides ISDN PRI connectivity between the Meridian 1 and Public Exchange/Central Offices in the following markets:

- Australia (30 B+D)
- Hong Kong (23 B+D)
- New Zealand
- Singapore (30 B+D)

The following ISDN features are supported for all Asia Pacific connectivities:

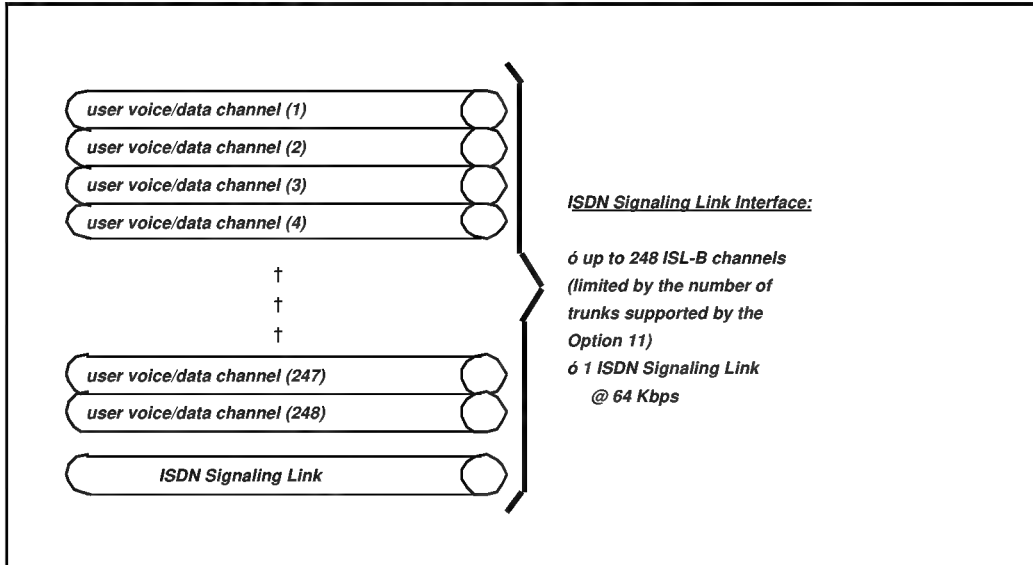
- Basic Call Service
- Calling Line Identification and Restriction (CLID and CLIR)
- Circuit switched voice and data on the B-channel

- Overlap Signaling as supported by each connectivity
 - Overlap Sending is supported by all interfaces (Australia, Hong Kong, and Singapore)
- COT, DID, DOD, and TIE trunk call types, as applicable
- 64 kbps unrestricted digital information
- Channel Negotiation
- Flexible Numbering Plan
- PRI Route Back-up with BRI routes, and
- Sub-addressing.

ISDN Signaling Link Interface (ISL)

ISDN Signaling Link allows Meridian 1 systems with digital and analog trunks to replace in-band signaling with out-of-band signaling. Analog or digital tie trunks are used: one trunk is designated as the D-channel while the remaining trunks act as B-channels.

Figure 3
ISDN Signaling Link (ISL) interface structure



D-channel

The D-channel can be a separate synchronous data circuit established over a leased line, or it can be an existing trunk circuit connected to standard communication equipment (modems or Meridian 1 data adapters).

The former is referred to as shared mode of operation, while the latter is known as dedicated mode.

Reverting to conventional signaling

If the ISL D-channel fails, trunk operation reverts back to in-band signaling. This is known as reverting to conventional signaling. A backup D-Channel can also be used, in which case "reverting to conventional signaling" would take place only when both D-Channels are out-of-service.

Possible ISL network configurations

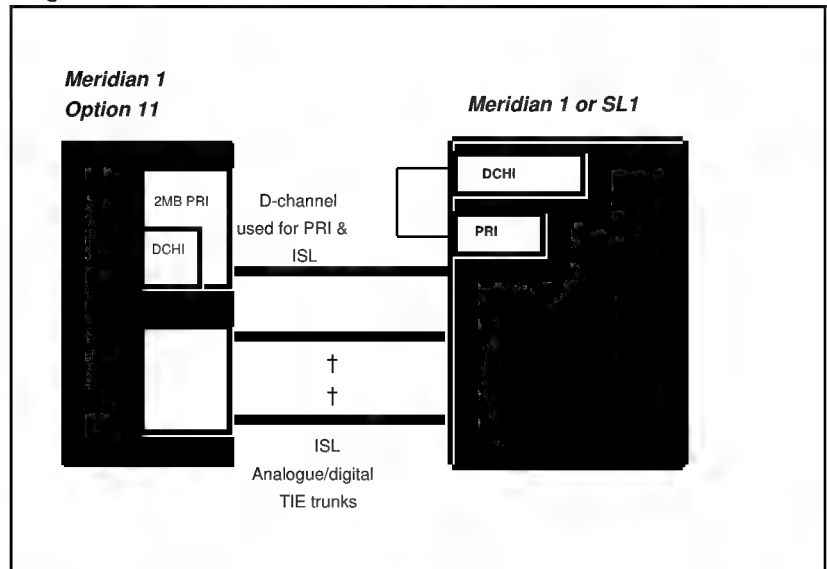
ISL is supported for Meridian 1/SL-1 to Meridian 1/SL-1 connections only.

Shared mode of operation

Shared mode requires PRI between two Meridian 1/SL-1 switches. The PRI can be either a 30B+D or an nB+D arrangement.

One of the analog or digital Tie trunks is used as a D-channel and is shared between the two switches. The shared D-channel transmits signaling information for the non-ISDN Tie trunks.

Figure 4
ISL Shared mode configuration

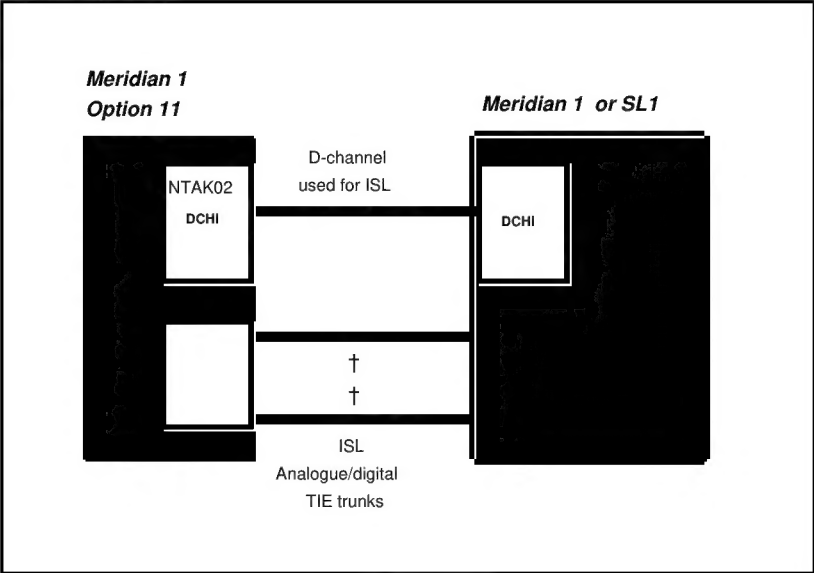


Dedicated mode

Dedicated mode is used when no PRI exists between the two Meridian 1/SL-1 switches, or when it is not desirable to share a D-channel.

A dedicated signaling (ISL) link is established and used to transport the signaling information for the non-ISDN trunks. The D-Channel can communicate with the far end through of a pair of dedicated line modems, dial-up modems, or Meridian 1 data adapters.

Figure 5
ISL Dedicated mode configuration



Integrated Digital Access (IDA)

IDA is used only in the United Kingdom and includes the following networking schemes:

- digital private network signaling system (DPNSS1)
- analogue private network signaling system (APNSS)
- digital access signaling scheme (DASS2)

Note: The NTBK50 2.0 Mb PRI card will not support IDA if the NTBK51 DDCH daughterboard is installed on the card. IDA is supported, however, if the NTAK93 DCHI daughterboard is used instead.

United Kingdom networking schemes require unique interfaces for compatibility with ISDN services. The APNSS, DPNSS1 and DASS2 gateway supports the following functions:

- basic call service (circuit switch voice calls)
- call line identification
- connected line identification
- call division
- coordinated dialing plan
- network ring again, between DPNSS1 and Q.931 protocols

Note: The NTBK50 2.0 Mb PRI card will support IDA only if the NTAK93 DCHI daughterboard is equipped. The NTBK51 Downloadable D-channel daughterboard does not support IDA.

DPNSS1 and DASS2

DPNSS1 and DASS2 are digital interfaces to UK ISDN networks. They conform to CCITT specification Q.931, but always use the 30B+D configuration. (Within the terminating exchanges, it is not necessary to configure all 30 B-channels for use).

DPNSS1 is used in private networks between PBX systems, while DASS2 is used between a PBX and a PSTN (Public Switched Telephone Network).

APNSS

APNSS is an analogue networking scheme that uses E&M trunk circuits on Meridian 1. The quantity of channels varies depending on traffic requirements. B-channels can be carried on a 2 Mb Digital Trunk Interface (DTI) or on a DPNSS1 B-channel in special cases.

The D-channel is normally established using modem equipment and a leased line, but it can be a digital channel in a suitable carrying medium. The D-channel is capable of running at any speed and can be over a digital or analogue link. If the D-channel is carried over a 64 Kbit digital link, a Data Line card must be provided for this function.

An analogue D-channel can also be established using leased line modems and connected by using dial-up modems, a 500 line card and any trunk circuit.

DPNSS1 and APNSS virtual channels

When using DPNSS1 or APNSS, and certain information is passed between two nodes that is not directly related to a call on a B-channel, a B-channel reference is required. An example of this is during the set up of the Call Back When Free feature.

The channel referenced in the message is referred to as a Virtual Channel. Virtual channels for DPNSS1 are the same as real B-channels, and have no effect on normal calls over B-channels.

Virtual channels for APNSS are programmed on an unused loop within the Option 11 system.

Channel configuration

DPNSS1 and DASS2 are message-based signaling systems which use a common signaling channel in timeslot 16. Each traffic channel has an associated Link Access Protocol (LAP). The LAPs operate in parallel over the signaling channel. Each traffic channel and its LAP represent one trunk.

A D-channel handler interface is informed of the configuration of its LAPs each time it is enabled. If a discrepancy between the hardware and software configurations is detected during call processing, the software attempts to correct the configuration of the DCHI.

UK gateway limitations

The UK gateway to ISDN is limited in that Public Switched Telephone Network (PSTN) incoming trunks are not allowed access to PSTN outgoing trunks.

Figure 6
Channel configurations for DPNSS1, APNSS, DASS2

